What is claimed is:

Sub A1

1. A method for calculating position and time of a GPS receiver comprising:

providing pseudoranges that are estimates of ~~estimate~~ the range of the GPS receiver to a plurality of GPS satellites;

providing an estimate of an absolute time of reception of a plurality of satellite signals;

providing an estimate of a position of the GPS receiver;

providing satellite ephemeris data;

computing absolute position and absolute time using said pseudoranges by updating said estimate of an absolute time and the estimate of position of the GPS receiver.

2. The method of claim 1 wherein said pseudoreanges are sub-millisecond pseudoranges.

3. The method of claim 1, wherein a first instance of said estimate of absolute time is in error by more than 10 milliseconds.

4. The method of claim 1, wherein said estimate of absolute time is provided by a clock that is not linked to a GPS reference time.

5. The method of claim 1, wherein said estimates of position and absolute time may be arbitrary guesses.

6. The method of claim 1, further comprising:

forming a-priori pseudorange-residuals; and

forming a mathematical model relating said a-priori pseudorange-residuals to said updates of said position and absolute time estimates; and

computing updates of the position and absolute time that fit the mathematical model.

7. The method of claim 6, wherein said a-priori range-residuals are a difference between expected ranges, from said satellites to said a-priori position estimate, and the pseudoranges.

8. The method of claim 6, wherein said expected ranges are computed at a time given by said a priori time estimate.

9. The method of claim 6, wherein said mathematical model is a linearization of a Taylor series of a non-linear mathematical model.

10. The method of claim 9, wherein said linearization is of the form:

$$u_i = [\partial\rho_i/\partial x,\ \ \partial\rho_i/\partial y,\ \ \partial\rho_i/\partial z,\ \ \partial\rho_i/\partial t_C,\ \ \partial\rho_i/\partial t_S]*[x,\ \ y,\ \ z,\ \ t_C,\ \ t_S]^T$$

where:

u_i is the a-priori range-residual, for one satellite;

ρ_i is the pseudorange for a satellite i;

x, y and z are three coordinates of position updates;

t_C is a common mode error update;

t_S is an absolute time of reception update; and

∂ denotes the partial derivative.

11. The method of claim 4, wherein one or more of the updates is assumed known, so that the remaining updates may be computed.

12. The method of claim 10, wherein one or more of the updates x, y, z, or t_c is assumed known, and set equal to an assumed value in the mathematical model, so that the remaining updates may be computed.

13. The method of claim 10, wherein one or more of the updates x, y, z, or t_c is assumed known, and added to the model as a pseudo-measurement so that the remaining updates may be computed.

14. A process as in claim 6, wherein other measurements or constraints are used in the mathematical model.

15. A process as in claim 6, wherein said a-priori position is obtained from a location of a radio tower used to communicate with a mobile device containing said GPS receiver.

16. A process as in claim 6, wherein said absolute time estimate is obtained from a real time clock in a server, said server being located remotely from said GPS receiver.

Sub A2

17. A method for calculating absolute time of a GPS receiver comprising:

providing pseudoranges that estimate the range of the GPS receiver to a plurality of GPS satellites;

providing an estimate of position of the GPS receiver; and

computing absolute time using the pseudoranges and the position estimate.

18. The method of claim 1 wherein said pseudoranges are sub-millisecond pseudoranges.

19. The method of claim 17, further comprising:

forming a-priori pseudorange-residuals; and

forming a mathematical model relating said a-priori pseudorange-residuals to updates of said estimate of position and absolute time; and

computing updates of the position and absolute time that fit the mathematical model.

20. The method of claim 19, wherein said a-priori range-residuals are a difference between expected ranges, from said satellites to said a-priori position estimate, and the pseudoranges.

21. The method of claim 19, wherein said expected ranges are computed at a time given by said a priori time estimate.

22. The method of claim 19, wherein said mathematical model is a linearization of a Taylor series of a non-linear mathematical model.

23. The method of claim 22, wherein said linearization is of the form:

$$u_i = [\partial\rho_i/\partial x,\ \ \partial\rho_i/\partial y,\ \ \partial\rho_i/\partial z,\ \ \partial\rho_i/\partial t_C,\ \ \partial\rho_i/\partial t_S]*[x,\ \ y,\ \ z,\ \ t_C,\ \ t_S]^T$$

where:

u_i is the a-priori range-residual, for one satellite;

ρ_i is the pseudorange for a satellite i;

x, y and z are three coordinates of position updates;

t_C is a common mode error update;

t_S is an absolute time of reception update; and

∂ denotes the partial derivative.

24. The method of claim 23, wherein one or more of the updates x, y, z, or t_c is assumed known, and set equal to an assumed value in the mathematical model, so that the remaining updates may be computed.

25. The method of claim 24, wherein one or more of the updates x, y, z, or t_c is assumed known, and added to the model as a pseudo-measurement so that the remaining updates may be computed.

26. A process as in claim 24, wherein other measurements or constraints are used in the mathematical model.

27. A process as in claim 24, wherein said a-priori position is obtained from a location of a radio tower used to communicate with a mobile device containing said GPS receiver.

28. A method of calculating a GPS position for a GPS receiver from partial pseudoranges that have ambiguity in a number of integer milliseconds, comprising:

a) choosing an a-priori position of the GPS receiver;

b) calculating integers conforming to said a-priori position;

c) calculating a navigation solution;

d) calculating a-posteriori residuals; and

e) using a relative size of said a-posteriori residuals to determine if said calculated integers are correct; and

f) repeating steps c), d) and e) using another a-priori position until residuals having a magnitude below a predefined threshold are computed.

pg. 15 line 2

29

29. A method as in claim 28, wherein said a-priori position is not within a specified distance of the actual receiver position.

30. A method as in claim 28, wherein said a-priori position is greater than 100km from the actual receiver position.

31. A method as in claim 28, wherein said a-priori position is greater than one integer millisecond from the actual receiver position.

32. A method as in claim 28, wherein said a-priori position is an arbitrary guess.

Sub A3

33. A system for computing position and time for a GPS receiver comprising:

a mobile device comprising a GPS receiver and a wireless transceiver;

a server being in wireless communication with said mobile device;

where said GPS receiver computes pseudoranges that estimate the range of the GPS receiver to a plurality of GPS satellites and the wireless transceiver transmits said pseudoranges to the server;

where the server computes an absolute position and absolute time for the GPS receiver using the pseudoranges and an estimate of position and time.

34. The system of claim 33 wherein said pseudoranges are sub-millisecond pseudoranges.

35. The system of claim 33 wherein the position estimate is a position of a radio tower coupled to the server that receives signals from the wireless transceiver.